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CLINICAL MANIFESTATION AND METHODS OF TREATMENT OF PODODERMATITIS IN DOGS

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Abstract. This paper provides data on the clinical signs of pododermatitis in dogs and also investigates effective treatment regimens. The urgency of the stated problem is due to the growing incidence of pododermatitis in dogs, its polyetiological nature, which requires a multifaceted approach to diagnostics and the introduction of effective treatments methods. Thereby, the purpose of the study was to investigate the clinical manifestations of skin diseases of the distal extremities in dogs and to determine the efficacy of complex therapy of pododermatitis. The studies were based on clinical research methods in dermatology, parasitological (skin scraping), bacteriological, and mycological (seeding on nutrient media with subsequent isolation of the pathogen) surveys. Based on the findings of the study, the absolute number of cases revealed lesions of 2 paws (53.3%), much less often – all 4 limbs (26.7%). It was found that mainly localisation of superficial skin lesions was found in 56.2% in the area of the interdigital space and 43.7% of cases – only on the plantar surface of the pastern (metatarsus), rarely – inflammation of the claw phalanx (31.2%). The main clinical signs of dermatitis of the distal extremities in dogs were erosive and ulcerative inflammation, alopecia, papules and pustules filled with purulent exudate, erythematous inflammation, haemorrhage, areas of lichenification. Studies on the treatment of dogs with pododermatitis caused by *Staphylococcus intermedius*, *Demodex canis* and *Malassezia pachydermatis* have shown the following: introduction of drugs Bravecto, Cefuroxime, Orungal, Apoquel and Derinat increased the efficacy of therapy in animals of the experimental group, as compared with the control (from 28.6% to 66.7%), reducing the duration of treatment to 21 days ($p < 0.01$) and extending the remission period to an average of 185 days ($p < 0.01$). The prospect of further research is the unification of clinical, morphological, and biochemical blood parameters as diagnostic criteria for pododermatitis in dogs

Keywords: pododermatitis, furunculosis, dogs, clinical signs, therapeutic efficacy



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INTRODUCTION

Diseases of the distal extremities in animals is a pressing issue in modern veterinary medicine. In Ukraine, productive farm animals were a traditional object for a detailed study of this group of pathologies [1; 2]. At the same time, there are currently research works in the world aimed at studying the inflammatory pathology of the distal extremities in dogs: R.M. Breathnach, K.P. Baker, P.J. Quinn, T.A. McGeady, C.M. Ahern, & B.R. Jones [3]; A.V. Bokarev [4]. However, insignificant attention has been paid to the study of the skin in this area. Notably, there are almost no special methods for studying diseases of the distal extremities in dogs. Most often, veterinarians use general diagnostic methods for this group of sick animals, with the appointment of classical measures for the treatment of dermatitis.

One of the important aspects of studying the problem of pododermatitis in dogs is the lack of research data on the pathogenesis of the disease. This leads to the lack of effective therapeutic and prophylactic regimes for this pathology. Often practicing veterinarians do not attribute pododermatitis to independent diseases, but consider them a link in dermatological diseases. This position leads to a number of dangerous medical errors: the use of monotherapy does not deliver a positive result; the sensitisation of dog's body with allergens complicates the disease progression; the treatment protocols do not provide a lasting clinical effect; sick animals are prescribed several courses of treatment without a positive result.

In contrast, in foreign countries, a comprehensive study of inflammatory pathology of the skin of the distal extremities in dogs is actively taking place. E. Bonsin'o, (2008) for many years conducted study on the clinical manifestations, pathogenesis, and treatment of dermatitis of the lower extremities in dogs. The scientist has found that drug treatment did not always ensure the recovery of sick animals and was the basis for further surgery [5]. Studies conducted by Peterson, Su (2000) have led to scientific interest in this pathology and highlighted the etiological factors of pododermatitis in dogs [6]. V.V. Velkov proposed original methods for the diagnosis and treatment of chronic pododermatitis in small animals. The proposed rehabilitation measures were based on an integrated approach using antibacterial, sensitising, and nonsteroidal drugs on the background of diet therapy and limb correction [7].

Foreign scientists are also conducting experiments to determine the most effective treatment regimens for dogs with pododermatitis, taking into account the etiological factor and the disease phase [8-9]. Pododermatitis is caused mostly by saprophytic microflora (bacterial and fungal) of the skin, which leads to increased pathological processes under conditions of reduced immune status. Since a significant number of skin diseases are accompanied by immunodeficiency, an important and mandatory component in the treatment

protocol are the means of general stimulant therapy. According to recent reports, administration of immunomodulators (Imudol, Katobevit, etc.) is recommended [10].

Given the urgency of this problem in veterinary medicine, the following should be noted:

1) practitioners pay insufficient attention to dermatitis of the lower extremities. However, in terms of pharmacological intervention, pododermatitis is much more difficult to treat than dermatitis of other localisation;

2) pododermatitis (even in simple form), induced by mechanical trauma, have a high tendency to transition to a chronic form;

3) most dermatitis of the distal extremities, which are registered at the primary reception, due to the long progression, lose contact with the initial factor and run as a polyetiological disease, not responding to monoethiotropic therapy [11-17].

The *purpose of the study* was to investigate the clinical manifestations of skin diseases of the distal extremities in dogs and to determine the effectiveness of complex therapy of pododermatitis in dogs.

MATERIALS AND METHODS

The study was conducted in the veterinary hospital in Feldman Ecopark (Kharkiv region, Dergachiv district) and the Department of Surgery Kalashnik of the Kharkiv State Zooveterinary Academy. Among all animals with a diagnosis of dermatitis admitted to the veterinary hospital in Feldman Ecopark during 2019-2020, 289 dogs were examined, including 116 with skin diseases of various localisations. In the structure of dermatological diseases included 16 dogs with dermatitis of the distal extremities.

The subjects for the study were dogs aged 5 to 17 years, outbred, of different sexes, with pathologies of the skin – interdigital abscess (duration of clinical symptoms ranged from 3 days to 8 months). Diagnostic studies were based on anamnestic data (age, condition, limb posture, comorbidities – elbow dysplasia, etc., response to treatment and propensity to relapse), clinical examination, and laboratory findings. Clinical examinations of animals were performed according to the generally accepted method (visual examination, palpation, diascopy), paying attention to the condition of the skin in the distal extremities [18]. Particular attention was paid to the presence of itching, its intensity, time of onset, nature of the exudate, local temperature, pain, localisation of skin rashes, alopecia, erythema, hyperpigmentation and lichenification in different parts of the body [19].

Diagnostic studies to detect canine scabies *Sarcoptes canis* and *Demodex canis* were performed by deep scraping of the skin from 5 affected areas until the appearance of blood. During the analysis of scrapings, the characteristic morphological features of mites of different species and their total number in the studied

material were taken into account [20]. To differentiate from dermatitis of fungal etiology, microscopy of hair and scales from the affected areas of the skin was carried out [21]. Bacteriological and mycological studies were conducted at the Institute of Dermatology and Venereology of the Academy of Medical Sciences of Ukraine (Kharkiv).

To study the effectiveness of various treatment regimens for pododermatitis in dogs caused by *Staphylococcus intermedius*, *Demodex canis* and *Malassezia pachydermatis*, two groups of animals were formed: experimental (n=9) and control (n=7). The disease was in an associative form. For the treatment of dogs of the control group the following drugs were used: Ivermek (manufacturer LLC Nita-Pharm, Russia, the active substance (AS) – ivermectin), at a dose of 0.3 mg/kg body weight (0.2 ml per 10 kg body weight) with an interval of 6 days (5 injections); Amitraz solution 2.5% (the drug was applied topically for 1 month, once every 3 days, multiplicity 5 times); Levomicol ointment (manufacturer Chervona Zirka, Kharkiv, AS – chloramphenicol – 7.5 mg, methyluracil – 40 mg) 2 times a day for 10 days; Nystatin (manufacturer Zdorovya pharmaceutical company, Kharkiv, AS – nystatin at a dose of 500,000 IU orally, once daily for 10 days); Allegra 180 mg (manufacturer Sanofi, France, AS – fexofenadine hydrochloride – 180 mg) was administered orally with food 1 pill once daily for 10 days; Sinulox (manufacturer Pfizer, USA, AS – amoxicillin trihydrate – 40 mg, clavulanic acid – 10 mg) was administered orally at a dose of 12.5 mg/kg body weight 2 times/day for 15 days. For the treatment of dogs in the experimental group the following drugs were used: Bravecto (manufacturer MSD Animal Health, Austria, AS – fluralaner, at a dose of 500 mg/kg body weight, given as a single dose); Novertin ointment (ISC Ukrzoovetprompostach, Ukraine, AS – aversectin C – 0.05 g) at the rate of 0.2 g/cm² once daily with an interval of 7 days, multiplicity – 3 times; Orungal (manufacturer Via S. Janssen, Italy, AS – itraconazole – 100 mg) at a dose of 10 mg/kg body weight, once daily for 10 days; Cefuroxime (manufacturer Sandoz, USA, AS – cefuroxime axetil – 500 mg) at a dose of 500 mg/kg body weight, 1 pill once daily for 7 days; Derinat (manufacturer Technomedservice, Russia, AS – sodium deoxyribonucleate) at a dose of 7.5 mg (0.5 ml) 1 injection with an interval of 72 hours, 5 injections in total. To facilitate the penetration of the drug through the skin of animals, keratolytic pet shampoo Keratolux was used (manufacturer Virbac, France, AS – salicylic acid, zinc gluconate, vitamin B6, piroctone olamine, fatty acids). To eliminate itching, Apoquel (manufactured by Zoetis, USA, AS – oclacitinib – 5.4 mg) was used orally at a dose of 0.4-0.6 mg per 1 kg of body weight of the animal 2 times a day for 21 days.

Evaluation of the effectiveness of therapeutic measures for pododermatitis in dogs was performed

according to clinical criteria. In particular, the dynamics of changes in the symptoms of the disease was determined; duration of treatment; the number of cured animals; the proportion of recurrences and their complications; remission period. Skin scrapings were examined every 3-4 weeks to determine tick and fungal agents. The duration of observations was two months, until 2 negative skin scrapings, negative bacteriological and mycological cultures were obtained.

RESULTS AND DISCUSSION

Analysing the results of studies, it was found that skin diseases of various etiologies are widespread. After examination of 289 dogs, dermatological pathologies were registered in 116 individuals, which is 40.13%. Pododermatitis in dogs from the total number of cases of skin diseases was diagnosed in 16 animals, which corresponds to 13.79%. Analysis of the etiological factors of the development of pododermatitis indicates the associative nature of dermatitis of the distal extremities in the examined sick dogs. Thus, the pathogen *Demodex canis* was found in (87.5%) patients, in 75% of animals – *Staphylococcus epidermidis* was isolated, and in 68.75% of dogs *Malassezia pachydermatis* was diagnosed.

Versatile macromorphological manifestations of pathological processes were revealed during external examination of distal extremities. Thus, 7 out of 16 dogs, which accounted for 43.7%, were diagnosed with general dermatitis along with pododermatitis. In most cases (9 dogs out of 16 – 56.2%) a local process was recorded, which was limited to the distal extremities and did not extend to the skin on other parts of the body.

As a result of the conducted examinations it was established that 2 paws (53.3%) were most often affected in dogs. There were frequent cases of pathology of all 4 extremities (26.7%), more sporadic cases of inflammation of one and three paws (12.5% and 6.2% – respectively). After external examination of the distal extremities in 16 dogs with pododermatitis, it was found that visual inflammation of superficial tissues was localised in:

1) in the form of inflammation, during which more tissues of the pastern (metatarsus) and fingers were affected – in 12 dogs (75%).

2) only in the interdigital space – in 9 dogs (56.2%);

3) only on the plantar surface of the pastern / metatarsus – in 7 dogs (43.7%);

4) only in the form of local inflammation of the claw phalanx, local inflammation of the claw folds and soft tissues, limited only to the phalanges of the fingers – in 5 dogs (31.2%);

5) only on the dorsal side of the pastern / metatarsus – in 2 dogs (12.5%).

Macromorphological visualisation of dermatitis of the distal extremities of dogs of different localisation is presented in Figures 1-3.



Figure 1. Inflammation of the dorsal side of the pastern



Figure 2. Inflammation of the plantar side of the pastern



Figure 3. Metatarsal panniculitis in dogs

Another important criterion for establishing a clinical diagnosis was the visualisation of the variability of tissue damage at the site of inflammation. Thus, the external signs of pododermatitis in dogs were: alopecia,

patches, erythema, haemorrhage, papules, vesicles, pustules, erosion, ulcers, necrosis, scars, lichenification and mixed type of damage. The findings are presented in the Table 1.

Table 1. Clinical signs of dermatitis of the distal extremities in dogs, %

Indicator	Erythema and haemorrhage	Alopecia and patches	Pustule / bulla	Papule / vesicle	Erosion and ulcers	Lichenification and scars	Mixed type	n (number of dogs)
Total	1	3	1	1	4	1	5	16
Total, %	6.25	18.75	6.25	6.25	25	6.25	31.25	100

In the vast majority of examined dogs (31.25%), a mixed type of damage was recorded in the area of inflammation of the distal extremities – simultaneous damage to superficial and deep tissues of varying intensity. Erosive ulcerative dermatitis ranked second in the

frequency of visual diagnosis (25%). Skin lesions of the distal extremities in the form of monomorphological variants in dogs were less common. In 18.75% of cases, the general signs of pododermatitis were characterised by alopecia and patches, in which epidermal disorders

were not observed. In other animals (6.25%) pododermatitis manifested as pustular, bullous, and papular rash with a haemorrhagic and purulent exudate, erythema and haemorrhage, and was characterised by fibrosis and lichenification. Thus, the main clinical signs of dermatitis of the distal extremities in dogs were erosive-ulcerative inflammation and alopecia. The scientific literature presents quite similar methods of therapy, which do not differ in variety. Treatment regimens were determined depending on the form of disease progression and the etiological factor. Treatment strategy involved the effect of drugs on the tissues, organs and systems of the dog's body, directly related to the pathogenesis of a disease [22].

Taking into account the etiological factors and pathogenesis of a disease, a clinical trial of two treatment regimens for pododermatitis in dogs caused by *Staphylococcus intermedius*, *Demodex canis* and *Malassezia pachydermatis* was developed and clinically tested. To study the effectiveness of different therapeutic regimens for pododermatitis in dogs, two groups of animals were formed (control and experimental), 7 and 9 patients, respectively.

The animals of the control group were treated with Ivermectin and a 2.5% Amitraz solution as an acaricidal preparation, Sinulox in combination with Levomikol was prescribed for antibacterial therapy, antifungal therapy was represented by Nystatin, as an antihistamine – Allegra.

Treatment of patients in the experimental group was carried out using the latest drugs. An insecto-acaricidal agent – Bravecto, to which there is no resistance among ticks and is safe for the body of animals, with the active substance Fluralaner, which blocks GABA-dependent and glutamate-dependent arthropod receptors. Fungicidal agent – Orungal, with the active substance itraconazole, which suppresses the synthesis of ergosterol and has a wide antifungal spectrum. Antibacterial agent – Cefuroxime, which belongs to the 2nd generation cephalosporin. In addition, drugs of general action were used: Apoquel, which refers to selective inhibitors of Janus kinase (JAK), Derinat – an immunomodulatory agent that activates the immune response to bacterial and fungal antigens, as well as a local keratolytic agent – Keratolux.

Analysis of the efficacy of treatment measures for pododermatitis in dogs caused by *Staphylococcus intermedius*, *Demodex canis* and *Malassezia pachydermatis* allowed establishing the following patterns (Table 2). The use of drugs Bravecto, Cefuroxime, Orungal, Apoquel compared with a combination of drugs Ivermectin, Levomikol, 2.5% solution of Amitraz, Allegra, Sinulox allowed increasing the proportion of dogs with complete healing by 2.3 times (from 28.7% to 66.7%), decreasing unsatisfactory treatment outcomes by 5.1 times (from 60.1% to 11.1%), and reducing the disease duration by 1.6 times ($p < 0.01$) with a prolongation of the remission period by 2 times ($p < 0.01$).

Table 2. Efficacy of treatment for associative pododermatitis in dogs

Indicator	Control		Experimental	
	amount	%	amount	%
Total amount of sick animals	7	100	9	100
Recovery	2	28.7	6	66.7
Improvements (positive dynamics)	1	11.2	2	22.2
Unaltered	4	60.1	1	11.1
Duration of treatment, days	35±3		21±3**	
Period of remission, days	90±2		185±4**	

Note: ** – $p < 0.01$

Based on the obtained results, it was found that the most common dermatitis of the distal extremities in dogs is caused by several etiological factors, including pathogens *Demodex canis*, *Malassezia pachydermatis* and *Staphylococcus epidermidis*. Studies have identified various macromorphological variants of pathological processes of pododermatitis in dogs. They are characterised by different depth and site of inflammation and the main clinical signs, which were represented by erosive-ulcerative inflammation and alopecia. The complex regimen developed taking into account the etiological factors and pathogenesis of the disease allows increasing the efficacy of treatment and improve the long-term prognosis. Therefore, this treatment regimen can be recommended

for the introduction in veterinary practice.

The obtained results on the complex treatment of pododermatitis in dogs can be traced by other researchers. Thus, it was found that in the chronicity of the disease it is expedient to use systemic glucocorticoids, 0.1% tacrolimus topical, and cyclosporine [23].

It was also found that the efficacy of treatment with antimicrobials after preliminary tests to determine the sensitivity of microorganisms was 98.6%, which indicates the elimination of the etiological factor. For the treatment of pododermatitis of bacterial etiology, it was useful to topically apply a solution of dimethyl sulfoxide in combination with enrofloxacin (10 mg/ml) and steroids (0.1 mg/ml). In chronic cases of *Malassezia*

pododermatitis in dogs, the pulse therapy was prescribed. Systemic therapy included oral administration of ketonazole at a dose of 5-10 mg/kg once daily (two consecutive days for three weeks). For topical therapy, shampoos containing 2% miconazole and 2% chlorhexidine solution (twice a week) were used, as well as lotions containing terbinafine, nystatin, and clotrimazole [24].

Many studies have been conducted using various etiotropic drugs for pododermatitis in dogs, indicating the high efficacy of the proposed treatment protocols. Researchers point out that for demodicosis it is necessary to carry out acaricide treatment using macrocyclic lactones, drugs from the isoxazoline class [25]. Other studies suggest the effectiveness of Amitraz at a concentration of 0.125% to 1.25% daily [26]. Scientists argue that for pododermatitis, accompanied by a secondary bacterial infection, it is necessary to use local and systemic antibiotic therapy. The latter should be continued for 1-2 weeks; for local treatments, shampoos with chlorhexidine (3-4%) and benzyl peroxide are used. Remarkably, this treatment regimen allowed controlling the main symptoms: itching and erythematous inflammation of the skin. But the study shows that after 2 months of treatment, recurrences of the disease were recorded in 2 animals. [27].

CONCLUSIONS

Pododermatitis of dogs in the structure of skin diseases accounted for 13.79% of all cases and had different macromorphological clinical variability. In dermatitis of the distal extremities in dogs, the main clinical symptoms were erosive-ulcerative and erythematous inflammation of the interdigital space, lichenification, fibrosis, ulcers, haemorrhage, alopecia areata, the presence of popular and pustular rashes with a haemorrhagic and purulent exudate. In most cases (75%), inflammation of the tissues was localised in the pastern (metatarsus) and fingers of dogs.

The associative nature of dermatitis of the distal extremities in the examined sick dogs was established. Thus, the pathogen *Demodex canis* was detected in (87.5%) patients, 68.75% of dogs were diagnosed with *Malassezia pachydermatis*, and 75% of experimental animals were diagnosed with *Staphylococcus epidermidis* (62.5%). The use of drugs Bravecto, Cefuroxime, Orungal, Apoquel compared with a combination of Ivermek, Levomicol, 2.5% Amitraz solution, Allegra, and Sinulox increased the proportion of animals with complete healing by 2.3 times (from 28.6% to 66.7%), reduced unsatisfactory results by 5.1 times (from 57.1 to 11.1%), as well as reduced the duration of treatment period by 1.6 times ($p < 0.01$) with extending the remission period by 2 times ($p < 0.01$).

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КЛІНІЧНИЙ ПРОЯВ І СПОСОБИ ЛІКУВАННЯ ПОДОДЕРМАТИТІВ У СОБАК

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Анотація. У представлений статті наведені дані щодо клінічних ознак за перебігу пододерматитів у собак, а також досліджені ефективні схеми їх лікування. Актуальність проблеми зумовлена зростанням випадків захворювання на пододерматити у собак, їх поліетіологічним характером, що потребує різнобічного підходу за проведення діагностичних тестів і впровадження ефективних способів лікування. У зв'язку з цим метою дослідження було вивчити клінічний прояв захворювань шкіри дистального відділу кінцівок у собак і визначити ефективність заходів комплексної терапії пододерматитів. Дослідження проводились на підставі клінічних методів дослідження у дерматології, паразитологічних (зіскрібків шкіри) бактеріологічних і мікологічних (висіви на поживні середовища із подальшим виділенням збудника). За результатами досліджень встановлено, що в абсолютній кількості випадків виявляли ураження 2-х лап (53,3 %), значно рідше всіх 4 кінцівок (26,7 %). Було з'ясовано, що в основному локалізація поверхневих уражень шкіри виявлялась у 56,2 % в області міжпальцевого своду та 43,7 % випадків – лише із підошовної сторони п'ясті (плюсни); рідше запалення зони кігтьової фаланги (31,2 %). Основними клінічними ознаками дерматиту дистального відділу кінцівок у собак були ерозійно-виразкове запалення та алопеції, папули та пустули, заповнені гнійним ексудатом, еритемне запалення, геморагії, ділянки ліхенізації. Під час досліджень щодо лікування собак, хворих на пододерматит, спричиненого *Staphylococcus intermedius*, *Demodex canis* та *Malassezia pachydermatis* було встановлено, що включення до комплексної схеми лікарських засобів «Бравекто», «Цефуроксим», «Орунгал», «Апоквель» та «Деринат» підвищило ефективність терапії у тварин дослідної групи, як порівняти із контролем (з 28,6 до 66,7 %) на тлі скорочення тривалості курсу лікування до 21 доби ($p < 0,01$) та подовження періоду ремісії в середньому до 185 днів ($p < 0,01$). Перспективою подальших досліджень є уніфікація клініко-морфологічних і біохімічних показників крові, як діагностичних критеріїв за пододерматиту в собак

Ключові слова: пододемодекоз, фурункулез, собаки, клінічні ознаки, терапевтична ефективність